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ABSTRACT

This study guide was developed for individuals preparing to take the Georgia Teacher Certification Test (TCT) in science. Content objectives of the test are listed and encompass: (1) scientific processes, research, and classification; (2) earth sciences; (3) characteristics and properties of matter, energy, and chemical change; (4) biology of life sciences; and (5) physics. References accompany each listing of objectives, and although they are general in nature, they address the specific concepts and published content objectives of the test. (JD)

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STUDY GUIDE FOR TCT IN SCIENCE

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to the Committee
Georgia Department of Education

June, 1983

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National Evaluation Systems, Inc., has prepared for distribution by the Georgia Department of Education the set of content objectives found in this Study Guide. These objectives have been verified as important content requirements for initial certification. Not all of the listed objectives have had test items written for them. The selected objectives have not been identified. All objectives which appear here are certification requirements and a sampling of them will be tested.

When the project to develop the Georgia Teacher Certification Tests (TCT) was begun in November 1976, an Ad Hoc Committee composed of Georgia educators was appointed to work with NES on each TCT. The function of these Ad Hoc Committees was to review all NES-generated materials with a goal of making the materials more reflective of Georgia education needs. The first step in the test development process was that of content domain specification. Educators identified all content knowledge that an applicant would need to know to function effectively in a Georgia school. This content was further defined into content objectives, which were sent to currently practicing Georgia educators for verification. These educators provided actual ratings of the "job-relatedness" of the content objectives. At that point, it was possible to identify, from the original domain specification, the extent of essentiality of specific content skills for successful performance on the job. Test items were written for the most essential objectives which spanned the content of the field.

The purpose of providing objectives is to explicitly define the content required of an applicant for certification in this field. Further, the statement of these objectives should assist in preparing for the criterion-reference content knowledge test. We encourage applicants to study these materials, which will enhance their understanding of the content field and alleviate any unnecessary concerns about the nature of the Georgia Teacher Certification Tests.

Along with these materials go hopes for a rewarding career in education.

If you have questions or desire further information, contact:

Performance-Based Certification
Division of Staff Development
1858 Twin Towers East
Atlanta, Georgia 30334
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Georgia Department of Education

Charles McDaniel, State Superintendent of Schools

Study Guide for TCT in Science

Georgia Teacher Certification Testing Program

Field 06: Science

The suggested references relate to the subareas of the Georgia Teacher Certification Test in Science and should prove to be quite useful in helping you to prepare for the test. The references are general in nature but do address the specific concepts and the published content objectives of the test. If you need help to master certain concepts, you may consult various references under the subject area as well as other related material in the public libraries, college/university media centers, and area college/university libraries. There are many other excellent reference books which have not been listed due to limited space.

Anotner way to prepare for each of these subareas would be to enroll in college level courses. This could be done on an audit basis or for credit.

The Science Test was developed by the National Evaluation Systems, Inc. and science educators in the State of Georgia. A number of science educators volunteered their time to develop the enclosed list of references keyed to the subareas to promote assistance to examinees in their preparation for the Science Test.

GEORGIA TEACHER CERTIFICATION TESTING PROGRAM

FIELD 06: SCIENCE

CONTENT OBJECTIVES

I. SCIENTIFIC PROCESSES

Given a research topic, identify sources and uses of appropriate information.

Use conventional systems and terms for labeling, naming, numbering, or coding phenomena.

Identify accurate uses of a variety of forms for recording observational or experimental date (e.g., graphs, tables, check lists, notes, etc.).

Classify phenomena using a variety of criteria.

Identify appropriate sequential representations of experimental or observational data using time lines, line graphs, etc.

Identify accurate uses of terms, symbols, illustrations, or models to represent data.

Abstract and/or summarize required information from experimental or observational data.

Decode information from graphic representations such as maps, graphs, charts, etc.

Given a set of data, identify reasonable inferences, interpolations, and extrapolations.

Select and use tests and criteria appropriate to the subject and purposes of analysis.

Relate principles, definitions, or concepts to accurate examples or analogies.

Compare experimental or observational data from different sources.

Derive new information from a reorganizatin of data.

Evaluate experimental or observational data in terms of specified criteria.

Given experimental or observational data, identify reasonable generalizations.

Estimate measurements of various properties (e.g., length, mass, volume, area, etc.).

Select appropriate units and instruments for measuring properties (e.g., length, area, mass, energy, etc.).

Measure various properties (e.g., length, area, mass, energy, etc.).

Measure mass, length, time, and volume, and identify appropriate units for each measurement.

Identify equipment needed to perform a specified task.

Identify the properties exhibited by a given scientific model.

Construct a graph from given information.

Analyze trends and identify and compare data included in various graphs.

Solve problems involving simple linear equations.

Use exponential notation to express numbers.

Identify size, significance, and effect of experimental error on a given experiment.

REFERENCES

I. SCIENTIFIC PROCESSES

Essential Mathematics for General Chemistry. Osburn, John Wiley and Sons, Inc., 1975.

A First Reader in Statistics. 2nd Ed., Freeman F. Elzey: Brookes/Cole Publishing Company, Monterey, California, 1974.

Ideas & Investigation in Science: Biology. 2nd Ed., Wong and Dalmatz, Prentice-Hall, Englewood Cliff, N.J., 1976.

Introductory Physical Science. 3rd Ed., U. Haker-Schalm, Cross, Abegg, Dodge, and Walter. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1977.

Learning Science Process Skills. Funt, et al., Kendall/Hunt Publishing Co., Dubuque, Iowa, 1979.

Modern Biology. Otto, Holt, Rhinehart and Windston Co., New York, 1977.

Schaum's College Chemistry. 6th Ed., J. L. Rosenberg: McGraw Hill, New York, 1980.

II. EARTH SCIENCES

Identify and compare the six major areas of the geologic time table.

Analyze the relationships among mass, weight, and density.

Identify the time it takes for one revolution of the earth around the sum.

Identify the time it takes for one rotation of the earth on its axis.

Identify ways in which the movement and tilt of the earth (relative to the sun) effect the seasons.

Identify the relationship between altitude and longitude and between longitude and time zones.

Identify the three major layers of the earth and analyze how layers are formed on the earth's crust by sedimentation.

Identify the ways in which different kinds of fossils were formed (e.g., preserved in ice, mineralized fossils, etc.).

Idenfity structural characteristics by which minerals are classified and identify properties of various common minerals.

Identify properties common to rocks and identify the major categories of rocks, (sedimentary, igneous, etc.).

Identify and compare the common kinds of metamorphic rocks.

Identify and compare the common kinds of igneous rocks.

Identify and compare the common kinds of sedimentary rocks.

Identify factors which influence air pressure.

Identify the major gases of which air is composed, and the proportions in which they occur.

Identify ways in which human activities alter the natural regulations of atmospheric composition, temperature, and pressure.

Decode weather maps and/or topographic maps.

Identify the different types of clouds (cumulus, status, etc.), and the characteristics which distinguish them.

Analyse ways in which geographical features (longitude, size of land, mass, land surface, elevation, etc.) influence climate.

Identify processes of the water cycle.

Identify effects of the major ocean currents on the climate of adjacent land masses.

Identify the major causes and effects of earthquakes.

Identify ways in which earthquake intensity is measured and/or interpret seismorgraphic data.

Identify major kinds of galaxies and their characteristics.

Identify major constellations from a star chart.

Identify categories of stars.

Identify major discoveries about the moon and the planets resulting from space exploration.

Identify theories concerning the origin of the solar system.

Analyze how the earth is influenced by the gravity of the sun and how the earth's gravity affects other bodies.

Identify ways in which the moon and the earth are influenced by each other.

Identify differences between a solar eclipse and a lunar eclipse, and/or identify the relative position of the sun, moon, and earth during eclipses.

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II. EARTH SCIENCE

The Ascent of Man. Bronowski, J. Little, Brown and Company, Boston, 1973.

Asimov's Guide to Science. Asimove, Issac. Basic Books, Inc., New York, 1972.

Astronomy: The Evolving Universe. Zeilik, Michael. Harper and Row, New York, 1979.

The Cambridge Encyclopedia of Astronomy. Mitton, Simon. Crown Publishers, 1978.

Cosmos. Sagan, Carl. Random House, Inc., New York, N.Y., 1980.

Earth Science. 3rd Ed., Tarbuck and Lutgens; Charles E. Merrill Publishing Co., Columbus, Ohio, 1979.

Ecology & Field Biology. Smith, Robert. Harper and Row, 1980.

A Guide to Field Identification Minerals of the World. Sorrell, Charles. Golden Press, New York, 1973.

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Our Changing Universe. Brandt, John. Charles Merrill Publishing Co., Columbus, Ohio, 1976.

Physical Geology. Foster, Robert J. Charels Merrill, 1975. (Maybe newer edition available).

The Physical Universe. 4th Ed., Drauskopf and Beiser; McGraw-Hill, Inc., New York, 1980.

The Rand McNally New Concise Atlas of the Universe. Moore, Patrick. Rand McNally and Co., 1978.

The Restless Universe. Shipman, Harry. Houghton Mifflin Co., 1978.

The Universe. Bergamini, David. Life Nature Library. Time Incorporated, 1966.

Weather: A Guide to Phenomena and Forecasts. Lehr, Paul. Golden Press, 1965.

Weather Around Us. Anthes, Richard. Charles Merrill, 1976.

III. MATTER

Identify the concepts of density, melting point, solubility, and/or boiling point.

Use characteristic properties to identify substances.

Distinguish between chemical and physical properties of matter.

Analyze physical changes, including related energy changes.

Analyze chemical changes, including related energy changes.

Identify characteristics of solids, liquids, and gases, including appropriate kinetic models.

Analyze the energy and entropy factors in phase changes.

Identify characteristics of phase equilibria and/or energy and entropy factors.

Using LeChatelier's principle, predict the effect that a given change will have on a system at equilibrium.

Identify the energy and entropy factors operant in a state of equilibrium.

Identify characteristics of solids, liquids, and gases, and state the basic conditions under which changes of state take place.

Distinguish between pure substances and mixtures.

Distinguish between elements and compounds.

Distinguish compounds from mixtures.

Identify distinguishing characteristics of metals, including relative position on the periodic chart.

Identify distinguishing characteristics of nonmetals, including relative position on the periodic chart.

Analyze the dissolving process, including energy and entropy factors.

Identify ways of expressing solution concentration, including percentages by weight, molarity, normality, and mole fraction.

Identify major characteristics of acids, bases, and salts (including use of indicators).

Identify the meaning of "pH" and how "pH" is measured.

Identify important properties of nonelectrolytes and/or distinguish them from electrolytes.

Identify the relationship between position of metals and nonmetals on the periodic table and ionization energy and electronegativity.

Identify how an element's electron configuration is related to its position on the periodic table.

Identify the electron configuration of an atom (up to at. no. = 18).

Identify qualitatively how the atomic structure of an atom determines its spectral pattern.

Predict bonding types according to electronegativity and the position of elements on the periodic chart.

Identify important properties of ions.

Identify the elements and the number of atoms of each element represented by the molecular formula of a given molecule.

Identify the correct representation of compounds by formulae and/or chemical reactions by balanced formula equations.

Recognize the concepts of a mole and of molar relationships.

Apply the concept of a mole to quantitive interpretations of chemical equations, gram molar volume, and molecular weight.

Identify ionic bonding and examples of it.

Identify covalent bonding and examples of it.

Analyze how the varying attraction of atoms for electron pairs affects the properties of a molecule.

Given the properties of compounds (melting point, hardness, conductivity, etc.), classify the bond type between elements as ionic, polar covalent, or non-polar convalent.

Apply the simple gas laws and the general gas equation to quantitative interpretation.

Interpret graphic representations of energy associated with chemical reactions.

Identify distinguishing characteristics of carbon bonding.

Distinguish between organic and inorganic compounds.

Classify a variety of types of organic compounds.

Identify terms of drug nomenclature and their meanings.

Identify how instrumentation (i.e., gas chromatography, spectrophotometry, X-Ray diffraction, spectroscopy) can be used as a tool in chemical analysis.

REFERENCES

III. MATTER

Modern Chemistry. H. C. Metcalfe, Williams, and Castka. Holt, Rinehart & Winston, New York, 1978.

Schaum's College Chemistry. 6th Ed., J. L. Rosenberg: McGraw Hill, New York, 1980.

General Chemistry. 6th Ed., W. H. Nebergall, Holtzclaw, and Robinson: D. C. Heath and Company, New York, 1976.

Keys to Chemistry. 2nd Ed. E. Ledbetter & Young; Addison-Wesley Publishing Co., New York, 1977.

Concepts in Chemistry. 3rd Ed., A. W. Greenstone, and Harris; Harcourt, Brace & Jovanovich, New York, 1975.

Chemistry: A Modern Course. Smoot, Price & Barrett; Charles E. Merrill Publishing Co., Columbus, Ohio, 1979.

A General Chemistry Review. N and N Publishing Company, Lydia Drive, Wappinger, New York 12590.

Programmed Units in Chemistry: Chemical Symbols. Prentice-Hall, Inc., 1977.

Programmed Units in Chemistry: Chemical Formulas and Names. Prentice-Hall, Inc. 1977.

Programmed Units in Chemistry: Molecular Weight Calculations. Prentice-Hall, Inc., 1977.

Programmed Units in Chemistry: Balancing Chemical Equations. Prentice-Hall, Inc., 1977.

Programmed Units in Chemistry: Mass and Volume Relationships. Prentice-Hall, Inc., 1977.

Essential Mathematics for General Chemistry. Osburn, John Wiley and Sons, Inc. 1975.

IV. BIOLOGY OF LIFE SCIENCES

Identify the concept of metabolism and examples of anabolism and catabolism.

Distinguish between sexual and asexual reproduction, and identify major advantages and disadvantages associated with each type of reproduction.

Identify some forms of asexual reproduction.

Identify the size, form, and life span of given organisms.

Analayze how environmental forces may influence biological variation.

Identify distinguishing characteristics of colloids and the role of colloids in biological systems.

Identify the chemical structure of carbohydrates and the role of carbohydrates in nutrition and metabolism.

Identify the chemical structure of proteins and the role of proteins in nutrition and metabolism.

Identify the chemical structure of lipids and the role of lipids in nutrition and metabolism.

Analyze the structure of enzymes and/or how they influence biological activity.

Recognize the basic principles and implications of biogenesis.

Identify the basic processes of abiogenesis and/or the conditions necessary for it to occur.

Identify the principles of underlying cell theory and analyze their significance.

Identify the principal components of the modern generalized cell model and their functions.

Distinguish between generalized plant cells and generalized animal cells.

Identify the basic types of animal tissue and the generalized functions for each type.

Identify the general structure of given organs and relate this structure to the organs' functions.

Identify the components, structure, and properties of given systems.

Define osmosis, identify factors which affect the direction and rate of osmosis, and describe the relationships between hypotonic, isoconic, and hypertonic solutions.

Identify diffusion and the factors that influence the rate at which it occurs.

Distinguish between active and passive transport by identifying examples of each.

Identify the function of respiration and/or distinguish between aerobic and anaerobic respiration in plants and animals in terms of energy yield and end product.

Analyze photosynthesis in terms of the conditions necessary for it to occur and/or its end products.

Analyze chemical reactions involved in the combination of amino acids to form proteins.

Identify the components and structure of nucleic acids and the relationship between nucleic acids and inheritance.

Identify the processes and significance of mitosis.

Identify the processes and significance of meiosis.

Identify the concept of genetic dominance and examples of it.

Identify the concept of genetic recessiveness and examples of it.

Identify genotype and examples of genotypes.

Identify phenotype and examples of phenotypes.

Identify examples of homozygous genotypes.

Identify examples of heterozygous geotypes.

Identify the principles and applications of chromosome theory.

Identify the principles and applications of gene theory.

Analyze the relationship between chromosomal damage and mutation.

Analyze how the principles of inheritance apply to selective breeding.

Identify examples of hybridization.

Identify the major categories and subdivisions in the taxonomy of organisms.

Identify the characteristics which determine the classification of an organism.

Identify the structure and/or functions of the internal skeletal system.

Identify the structure and/or functions of the three types of muscles.

Identify the components, structure, and functions of the generalized, closed circulatory system.

Identify the components, structure, and functions of the generalized digestive system.

Identify the components, structure, and functions of the male and female mammalian reproductive organs.

Identify the components, structure, and functions of the generalized vertebrate excretory system.

Identify components of the generalized vertebrate endocrine system and the hormones they produce.

Analyze the concept of homeostasis and/or identify processes which maintain homeostasis.

Identify the three types of foods, vitamins,and minerals necessary for good nutrition, and/or diseases which result from specific nutritional deficiencies.

Identify the basic tropisms and mechanisms by which they occur.

Identify some possible reasons for migration in a given situation.

Analyze the concept of the biosphere.

Identify characteristics by which various kinds of ecosystems are distinguished.

Analyze the concept of a natural community and/or how organisms in a community are categorized (e.g., consumers, producers, decomposers).

Relate niches to natural communities.

Analyze the effects of population growth and/or mortality on ecological systems.

Identify components of the abiotic environment.

Analyze the concepts of a food web and a food chain and/or interpret diagrams showing the food web in an ecosystem.

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IV. BIOLOGY OF LIFE SCIENCES

Biology: Living Systems. Oram, Raymond; Charles E. Merrill Publishing Co., Columbus, Ohio, 1979.

Exploring Life Science. Thurber & Kilburn; Allyn & Bacon, New York, 1981.

Modern Biology. Otto; Holt, Rhinehart & Winston, New York, 1977.

Invitation to Biology. 3rd Ed., Curtis, H. and Barnes, N.W. Worth Publishers, Inc., 1979.

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Biology. Norstog, Knot and Andrew J. Meyerriecks; Charles E. Merrill Publishing Co., Columbus, Ohio, 1983.

Biology: The Essential Principles. Graham, Tom M. Saunders College Publishing, New York, 1982.

Biology: The Unity and Diversity of Life (second edition). Starr, Cecie and Ralph Taggart, Wadsworth Publishing Co., Belmont, California, 1981.

The Science of Biology (fifth edition). Weisz, Paul B. and Richard N. Keogh, McGraw-Hill Book Co., New York, 1982.

Inquiry Into Life (third edition). Mader, Sylvia. William C. Brown Co., Dubuque, Iowa, 1982.

Biology: The Science of Life. Wallace, Robert A., Jack L. King and Gerald P. Sanders. Goodyear Publishing Co., Inc., Santa Monica, California, 1981.

Biology, 2nd edition. Arms, Karen and Pamela S. Camp. Saunders College Publishing, New York, 1982.

Biological Sciences. Third edition. Keeton, William T., W. W. Norton and Co., New York, 1980.

V. PHYSICS

Apply the concepts of linear velocity and acceleration.

Identify properties of frictional forces and/or dependence of gravity upon separation distance.

Apply the concept of conservation of momentum.

Identify the concepts of work, power, kinetic and potential energy, and/or analyze the relationships among them.

Apply the concepts of the conservation of mass and energy.

Solve problems involving levers, pulleys, and inclined planes.

Solve problems involving thermal expansion.

Distinguish between the concepts of temperature and heat.

Analyze how waves are transmitted in different mediums and the relation of speed of transmission to wave length and frequency.

Identify how the speed of light depends on the medium and that white light is composed of colored light of different frequencies.

Identify ways in which sound is generated and transmitted in different mediums.

Distinguish between refraction and reflection of light.

Identify how the loudness and pitch of sound are determined and/or identify factors which cause variation in loudness or pitch.

Identify origins of electrostatic charges and electrical currents.

Distinguish between AC and DC circuits, analyze the amplitude and frequency of AC signals, and/or solve simple direct current problems.

Identify characteristics of permanent magnets and electromagnets.

Identify sources of energy (e.g., chemical, nuclear, etc.).

Analyze the concept of pressure and relate liquid pressure to liquid density, depth, and flow rate.

Distinguish between vectors and scalars.

Peform scalar and vector mathematical operations (e.g., add and subtract scalars and vectors, multiply scalars and vectors, and form scalar and vector products of vectors).

Identify conditions necessary for static and/or dynamic equilibrium.

Determine the average speed of an object.

Determine the velocity of moving objects by analyzing their speed and direction.

Determine the average acceleration of an object.

Determine trajectories of objects under a constant force and/or solve problems involving circular motion.

Calculate the gravitational force of attraction between two objects.

Calculate the electrical and magnetic force on charged objects.

Distinguish between impulse and momentum.

Determine the amount of work done by different forces.

Calculate kinetic and potential energy and/or solve problems involving conservation of energy.

Analyze how measurements are dependent upon a frame of reference.

Solve problems involving Hooke's Law and/or simple harmonic motion.

Solve problems involving the relationship between speed of propagation, wave length, and frequency.

Distinguish between wave diffraction and interference.

Analyze the concepts of intensity and frequency of sound waves and/or identify the harmonic overtone composition of sound.

Identify Coulomb's Law and/or the concepts of electrical field and potential difference.

Identify the concepts of capacitance and resistance and/or relate voltage and current in capacitors and resistors.

Define the concept of electric current, apply Ohm's Law and identify the functions of capacitors and resistors.

Solve problems involving DC electric circuits and/or apply Kirchhoff's Laws to series and parallel resistance formulae.

Identify electromagnetic induction and/or the ways in which a magnetic field is produced by a current.

Analyze the application of electromagnetic induction to generators and motors.

Analyze the concept of inductance and/or the relationship of voltage and current in an inductor.

Solve simple problems involving AC circuits.

Analyze basic atomic structure, including the names and characteristics of three major subatomic particles, their relative positions in an atom, and the relationship of size of nucleus to size of atom.

Identify photoelectric effect and how it is explained by quantum theory.

Identify major types of radioactive elements and/or the position of radioactive elements on the periodic table.

Identify distinguishing characteristics of isotopes.

Identify the major types of radioactivity and their distinguishing characteristics.

Distinguish the processes of fission and fusion and/or identify uses of nuclear energy.

Identify uses of simple common measuring devices used in physics.

Interpret simple circuit diagrams.

Identify general characteristics and uses of semiconductors.

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V. PHYSICS

The Physical Universe. 4th ed., Krauskopf and Beiser; McGraw-Hill, Inc., New York, 1979.

Principles of Physics. 4th ed., Bueche; McGraw-Hill, Inc., New York, 1978.

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a. Mathematics for Physical Science
b. Electricity and Electromagnetic Fields
c. Mechanics, Heat & Sound
d. Modern Physics